International Journal of Agricultural
Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 6, Issue 6, Dec 2016, 409-414

TRANS STELLAR
•Journal Publications •Research Consultancy

ASSESMENT OF DIFFERENT HERBICIDES ON YIELD AND ECONOMICS OF *KHARIF* MAIZE (*ZEA MAYS* L.)

CH RAMA RAO[1], P V N PRASAD[2] & B VENKATESWARLU[3]

[1] *PG Student, Department of Agronomy, Agricultural College (ANGRAU). Bapatla, Andhra Pradesh, India*

[2] *Principal Scientist and Head, Agronomy, Agricultural College Farm, Bapatla, Andhra Pradesh, India*

[3] *Principal Scientist and Head, Agronomy, Agricultural Research Station, Garikapadu, Andhra Pradesh, India*

ABSTRACT

A field experiment was conducted at Agricultural College Farm, Bapatla on sandy clay loam soil during the kharif 2014 to study the effect of pre-emergence (Atrazine @ 1.0 kg a.i ha^{-1} and pendimethalin @ 1.0 kg a.i ha^{-1}) and post-emergence (Topramezone @ 25 g a.i ha^{-1}) herbicides on growth and yield of maize. Hand weeding at 20 and 40 DAS recorded the highest plant height, drymatter accumulation, kernel yield and harvest index, which was statistically on a par with atrazine @ 1.0 kg a.i ha^{-1} fb topramezone @ 25 g a.i ha^{-1} at 20 DAS and pendimethalin @ 1.0 kg a.i ha^{-1} fb topramezone @ 25 g a.i ha^{-1} at 20 DAS. The highest weed index (45.8%) was recorded in weedy check (T_1). The highest returns per rupee investment was recorded with atrazine @ 1.0 kg a.i ha^{-1} (PE) fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (2.00) and was followed by pendimethalin @ 1.0 kg a.i ha^{-1} (PE) fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (1.73) and where as the returns per rupee investment with hand weeding at 20 and 40 DAS (1.41).

KEYWORDS: Maize, Pre and Post-Emergence Herbicides, Yield, Economics

Received: Nov 03, 2016; **Accepted:** Dec 02, 2016; **Published:** Dec 07, 2016; **Paper Id.:** IJASRDEC201653

Original Article

INTRODUCTION

Maize, a cereal kernel produced worldwide, assume importance to subsistence and commercial farmers alike while occupying a prominent position in global agriculture. In India, it covers an area of 9.43 million hectares producing 24.35 million tones annually. (Ministry of Agriculture, Government of India, 2013-14) and ranks third after rice and wheat in terms of production besides contributing nearly 9% to the national food basket.

Maize, which is mostly grown as rainfed crop during *kharif* faces a formidable weed problem, which competing severely for growth resources and the yield loss may extend from 33 to 50 Per cent (Sharma *et al.*, 2000). Maximum yield loss due to weed competition occur during the first 3-6 weeks, i.e., before the canopy has developed thick enough to smother the weeds (Shad *et al.,* 1993). Wider row spacing and initial slow crop growth (Nagalakshmi *et al.,* 2006) makes maize highly sensitive to weed competition upto 6 weeks growth period. Thus, to realize optimum yields a demands during the initial 6 weeks of crop growth thorough weed management is considered critical for crop weed competition. Rainy season with heavy and continuous rains coupled scarcity of labour, renders difficult to control the weeds by conventional, cultural and mechanical methods. Thus, chemical weed control assumes significance in the cultivation of maize. Herbicides not only curb the weeds timely and effectively but also offer greater scope for minimizing the cost of weed control irrespective of the situation. Use of pre and post-emergence application of herbicides would make herbicidal weed control more acceptable to farmers which will not change the existing agronomic practices but will allow for complete

control of weeds. Pre-emergence application of herbicides will control the weeds upto 25 days and thereafter post-emergence application is given so that further growth of weeds can also be controlled. An investigation was carried out to the sequential application of pre-emergence and post-emergence herbicides in maize during *kharif* 2014

MATERIAL AND METHODS

A field experiment was conducted during *kharif* 2014 at Agricultural College Farm, Bapatla on sandy clay loam soil with pH 7.4, medium in organic carbon (0.52%), low in available N (258 kg ha^{-1}), high in available P (53.9 kg ha^{-1}) and available K (539.8 kg ha^{-1}). The experiment was laid out in Randomized Block Design with nine weed control treatments replicated thrice. The maize hybrid 'LAXMI 2277' was sown by hand dibbling and the crop was grown by adopting the recommended package of practices. Application of nitrogen as per the recommended dose of (120 kg ha^{-1}) was applied in three splits (50% as basal application, 25% at 30 DAS and 25% at 45 DAS) in the form of urea. Entire dose of phosphorus (60 kg P_2O_5 ha^{-1}) in the form of single superphosphate (SSP) and potassium (50 kg K_2O ha^{-1}) in the form of muriate of potash (MOP) were applied as basal at the time of sowing. Weed control in experimental plots was done as per the treatments proposed for evaluation. Calibrated quantity of herbicides were applied as aqueous spray (500 L ha^{-1}) with a manually operated knapsack sprayer fitted with flat fan nozzle. Pre-emergence application of herbicide was done within 24 hours of sowing and post-emergence application of topramezone @ 25 g a.i ha^{-1} at 20 DAS. Data on weeds was recorded at four places per plot at 30, 60, 90 DAS and at maturity using a quadrant of 0.25 m^2. Observations on crop such as plant height, drymatter accumulation were recorded at 30, 60, 90 DAS and at maturity as per standard procedure. Kernel and stover yield under various treatments were recorded separately and analyzed statistically. Data pertaining to weed index was subjected to arc sin transformation for statistical analysis. Statistical analysis for the data recorded on weeds and maize crop was done following the analysis of variance technique for Randomized Block Design as suggested by Gomez and Gomez (1984). Statistical significance was tested by applying F-test at 0.05 level of probability and critical differences were calculated for those parameters which were found significant ($p \leq 0.05$) to compare the effects of different treatments. Based on the prevailing market price of the produce and cost of cultivation, the net returns and returns per rupee investment were computed. Harvest index (Donald and Humblin, 1976) and weed index (Gill and Vijaykumar, 1969) were calculated as per the standard formulae.

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (kg ha}^{-1})}{\text{Biological yield (kg ha}^{-1})} \times 100$$

Biological yield = (Kernel yield + Stover yield)

$$\text{Weed index (\%)} = \frac{X - Y}{X} \times 100$$

Where,

X = Yield from weed free plot

Y = Yield from plot for which weed index is to be worked out

RESULTS AND DISCUSSIONS

Weed Flora

Cyperus rotundus among sedges, *Trianthema portulacastrum, Cleome viscosa, Euphorbia hirta* and *Phyllanthus niruri* among dicots and *Cynodon dactylon, Panicum repens* and *Dactyloctenium aegyptium* among grasses were the predominant weed species observed in the experimental field.

Effect on Crop growth and Yield

Plant height and drymatter accumulation in maize (Table 1) at 30, 60, 90 DAS and at maturity were the highest under hand weeding at 20 and 40 DAS (T_2), pre-emergence application of atrazine @ 1.0 kg a.i ha^{-1} fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (T_9) and pre-emergence application of pendimethalin @ 1.0 kg a.i ha^{-1} fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (T_8) were on a par with T_2 reflecting good weed control achieved in these treatments. At 30 DAS, the highest drymatter accumulation (615 kg ha^{-1}) by maize was recorded in pre-emergence application of atrazine @ 1.0 kg a.i ha^{-1} fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (T_9), which was on a par with T_4, T_8, and T_3 treatments.

Sequential application of atrazine @ 1.0 kg a.i ha^{-1} (PE) fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (T_9) and pre-emergence application of pendimethalin @ 1.0 kg a.i ha^{-1} fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (T_8) recorded (Table 2) a kernel yield of 5627 kg ha^{-1} and 5282 kg ha^{-1}, respectively and these treatments were statistically on a par with hand weeding at 20 and 40 DAS, which recorded the highest kernel yield (5974 kg ha^{-1}). Similar trend was observed in stover yield as well under different weed control treatments, might be due to greater availability of nutrients under lower weed competition, which might have promoted higher production and better translocation of photosynthates from source to sink. Severe weed competition reduced crop growth and drymatter accumulation in weedy check (T_1) which resulted in the lowest kernel yield (2917 kg ha^{-1}). Pre-emergence herbicides alone could not improve the yield as they failed to reduce the weed germination and growth during the later part of the critical period of crop weed competition. Similar results were also reported by Aleem *et al*. (2012), Sandhyarani *et al.* (2013) and Sonawane *et al*. (2014).

Harvest Index

Data presented in (Table 1) revealed that significant differences were not observed in harvest index due to different weed control treatments. However, higher (43.2%) and lower (39.1%) harvest indices were recorded with hand weeding at 20 and 40 DAS (T_2) and weedy check (T_1), respectively. The increased harvest index might be due to greater translocation of photosynthates as evidenced by higher yields. These results are in conformity with those reported by Srividya (2010) and Nagalakshmi *et al*. (2006).

Weed Index

The highest weed index (45.8%) was recorded (Table 1) in weedy check (T_1) indicating that uncontrolled weed competition during the crop period caused 45.8 per cent of yield loss. Pre-emergence application of atrazine @ 1.0 kg a.i ha^{-1} fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (T_9) and showering of pendimethalin @ 1.0 kg a.i ha^{-1} fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (T_8) recorded a weed index of 13.9% and 18.1%, respectively. Slow growth of crop in the early stages offered much scope for the development of weeds besides competitiveness of weeds in utilizing the resources which resulted in more loss of yield (Patel *et al.,* 2006). This clearly indicated that the sequential use of pre-emergence herbicides followed by post-emergence spray at 20 DAS was the most effective approach in controlling weeds and thus resulted in recording significantly lower values for weed index. These findings are in conformity with the findings of

Sreenivas *et al.* (1992) and Shantveerayya and Agasimani (2012).

Economics

Respite highest gross returns (Rs. 81581 ha^{-1}) was recorded (Table 2) with hand weeding at 20 and 40 DAS (T_2), the net returns recorded was the highest with atrazine application @ 1.0 kg a.i ha^{-1} PE fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (Rs. 51340 ha^{-1}) followed by hand weeding at 20 and 40 DAS (Rs. 47744 ha^{-1}) and pendimethalin @ 1.0 kg a.i ha^{-1} PE fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (Rs. 45790 ha^{-1}). The highest returns per rupee investment was recorded with atrazine @ 1.0 kg a.i ha^{-1} PE fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (2.00) and was followed by pendimethalin @ 1.0 kg a.i ha^{-1} PE fb topramezone spray @ 25 g a.i ha^{-1} at 20 DAS (1.73) and hand weeding at 20 and 40 DAS (1.41). This could be attributed to the increased cost of labour for manual weeding, which increased the cost of cultivation. While the low cost of herbicides reduced the cost of cultivation in herbicidal treatments. These results are in agreement with Deshmukh *et al*. (2014).

CONCLUSIONS

Thus pre-emergence application of either atrazine or pendimethalin @ 1.0 kg a.i ha^{-1} fb post-emergence application of topramezone @ 25 g a.i ha^{-1} at 20 DAS as the most cost effective weed control measure in maize. Topramezone would be complement to current weed management program in kernel maize. Alternatively it can be used in sequential application to pre-emergence soil applied treatments (Porter *et al.,* 2005).

ACKNOWLEDGEMENTS

Necessary facilities provided by Agricultural College Farm and Department of Agronomy, Agricultural College, Bapatla are acknowledged. The work was carried out by utilizing the grants received from Acharya N.G. Ranga Agricultural University, Guntur

REFERENCES

1. *Aleem Ahmed, M.A and Susheela, R. 2012. Weed management studies in kharif maize. Journal of Research, ANGRAU. 40 (3):121-123.*
2. *Deshmukh, J.P., Singrup, P, Dandge, M.S., Bhale, V.M and Paslawar, A.N. 2014. Integrated weed management in maize. Biennial Conference of Indian Society of Weed Science.Pp-81.*
3. *Donald, C.M and Humblin, J. 1976. The biological and harvest index of the cereals as agronomic and plant breeding criteria. Advances in Agronomy. 28: 361-405.*
4. *Gill, G.S and Vijaykumar, K. 1969. Weed index a new method for reporting weed control trials. Indian Journal of Agronomy. 14 (2): 96-98.*
5. *Gomez, K.A and Gomez, A.A. 1984. Text book on Statistical procedures in agricultural research. New York Chichester Wiley. 2nd edition. Pp-680.*
6. *Ministry of Agriculture, Government of India. 2013-14. http:// www.indiastat.com*
7. *Nagalakshmi, K.V.V., Chandrasekhar, K and Subbaiah, G. 2006. Weed manage- ment for efficient use of nitrogen in rabi maize (Zea mays). The Andhra Agricultural Journal. 53 (1&2): 14-16.*
8. *Patel, V.J., Upadhyay, P.N., Zala, S.V and Patel, B.D. 2006. Residual effect of herbicide applied as alone and mixture to kharif maize on succeeding rabi oat and mustard. Indian Journal of Weed Science. 38 (3&4): 258-262.*

9. *Porter, R.M., Vaculin, P. D., Orrr, J. E., Immaraju, J.A and O Neal, W.B. 2005. Topramezone a new active for post-emergence weed control in corn. In: North Central Weed Science Society Proceedings. 60:93.*
10. *Sandhyarani, B and Karunasagar, G. 2013. Effect of integrated weed manage- ment on growth, yield and economics of sweet corn. Agricultural Science Digest. 33 (1): 52-55.*
11. *Shad, R.A., Chatha, M.Q and Nawaz, H. 1993. Weed management studies in maize. Pakistan Journal of Agricultural Research. 14 (1): 44-50.*
12. *Shantveerayya Hawaldar and Agasimani, C.A. 2012. Effect of herbicides on weed control and productivity of the maize. Karnataka Journal of Agricultural Sciences. 25 (1): 137-139.*
13. *Sharma, A.R., Toor, A.S and Sur, H.S. 2000. Effect of interculture operations and scheduling of atrazine application on weed control and the productivity of rainfed maize (Zea mays) in Shiwalik foothills of Punjab. Indian Journal of Agricultural Sciences. 70 (11): 757-761.*
14. *Sonawane, R.K., Dandge, M.S., Kambel, A.S and Shingrup, P.V. 2014. Effect of herbicides on nutrient uptake by weeds, crops and yield of kharif maize. Biennial Conference of Indian Society of Weed Science. Pp-95.*
15. *Sreenivas, G., Satyanarayana, V and Chandrasekhar Rao, P. 1992. Integrated weed management in the grain maize (Zea mays). Journal of APAU. 20(1): 27-29.*
16. *Srividya, S. 2010. Effect of tillage and herbicide use on the growth and yield of maize. M.Sc (Ag) Thesis submitted to Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad.*

APPENDICES

Table 1: Plant Height, Drymatter Production, Harvest Index and Weed Index as Influenced by Different Weed Control Treatments in Maize

Treatments	Plant height (cm)				Drymatter production (kg ha^{-1})				Harvest index (%)	*Weed index (%)
	30 DAS	60 DAS	90 DAS	Maturity	30 DAS	60 DAS	90 DAS	Maturity		
T1 - Weedy check	49.2	126.8	173.6	189.2	340	2570	3211	4486	39.1	45.8 (51.4)
T2 - Hand weeding at 20 & 40 DAS	64.5	203.7	228.1	232.5	401	4491	7686	10175	43.2	0.0 (0.0)
T3 - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE)	59.2	150.1	183.2	190.8	581	3185	4937	5876	41.9	37.2 (36.5)
T4 - Atrazine @ 1.0 kg a.i ha^{-1} (PE)	62.8	156.4	184.5	193.4	604	3328	5644	6938	41.4	36.9 (36.0)
T5 - Topramezone @ 25 g a.i ha^{-1} at 20 DAS (POE)	57.8	169.5	196.7	203.1	386	3621	6328	7997	41.7	34.6 (32.2)
T6 - Topramezone @ 25 g a.i ha^{-1} at 40 DAS (POE)	46.0	135.9	183.2	199.1	348	2620	3298	4607	39.7	40.0 (41.6)
T7 - Topramezone @ 25 g a.i ha^{-1} at 20 & 40 DAS (POE)	58.8	180.7	203.7	209.4	374	3434	6662	8758	41.4	28.4 (22.6)
T8 - Pendimethalin @ 1.0 kg a.i ha^{-1} fb topramezone @ 25 g a.i ha-1 at 20 DAS (POE)	60.5	184.5	209.9	217.9	585	4032	6883	9185	42.1	18.1 (11.4)
T9 - Atrazine @ 1.0 kg a.i ha^{-1} fb topramezone @ 25 g a.i ha-1 at 20 DAS (POE)	63.6	194.8	216.7	224.9	615	4300	7085	9776	42.4	13.9 (5.8)
SEm±	**2.29**	**6.89**	**7.43**	**6.61**	**23.6**	**215.6**	**277.8**	**381.6**	**2.00**	**1.95**
CD (p=0.05)	**6.9**	**20.7**	**22.3**	**19.8**	**71**	**646**	**833**	**1144**	**NS**	**5.8**
CV (%)	**6.8**	**7.2**	**6.5**	**5.5**	**8.4**	**10.6**	**8.3**	**8.8**	**8.3**	**11.9**

*Arc sin transformed values. The figures in parentheses are original values

Table 2: Effect of weed Control Treatments on yield and Economics of Maize

Treatments	Kernel yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Gross returns (Rs. ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	Returns per rupee investment (Rs.)
T_1 - Weedy check	2917	4477	40160	22337	17823	0.80
T_2 - Hand weeding at 20 & 40 DAS	5974	7837	81581	33837	47744	1.41
T_3 - Pendimethalin @ 1.0 kg a.i ha^{-1} (PE)	3791	5285	51926	24422	27504	1.13
T_4 - Atrazine @ 1.0 kg a.i ha^{-1} (PE)	3822	5418	52395	23537	28858	1.23
T_5 - Topramezone @ 25 g a.i ha^{-1} at 20 DAS (POE)	4048	5656	55452	24437	31015	1.27
T_6 - Topramezone @ 25 g a.i ha^{-1} at 40 DAS (POE)	3482	5249	47891	24437	23454	0.96
T_7 - Topramezone @ 25 g a.i ha^{-1} at 20 & 40 DAS (POE)	4623	6564	63381	26537	36844	1.39
T_8 - Pendimethalin @ 1.0 kg a.i ha^{-1} fb topramezone @ 25 g a.i ha^{-1} at 20 DAS (POE)	5282	7291	72312	26522	45790	1.73
T_9 - Atrazine @ 1.0 kg a.i ha^{-1} fb topramezone @ 25 g a.i ha^{-1} at 20 DAS (POE)	5627	7652	76977	25637	51340	2.00
SEm±	**213.3**	**331.6**	-	-	-	-
CD (p=0.05)	**640**	**994**	-	-	-	-
CV (%)	**8.4**	**9.3**	-	-	-	-

Input Costs Output Prices

Seed	-	Rs. 275 kg^{-1}	Atrazine	-	Rs. 300 kg^{-1}	Price of grain	- Rs. 13 kg^{-1}
Urea	-	Rs. 5.62 kg^{-1}	Pendimethalin	-	Rs. 450 L^{-1}	Price of stover	- Rs. 0.50 kg^{-1}
SSP	-	Rs. 7.8 kg^{-1}	Topramezone	-	Rs. 1500 75 ml^{-1}		
MOP	-	Rs. 17.64 kg^{-1}	Spraying cost	-	Rs. 300 day^{-1}		
Labour cost	-	Rs. 150 head^{-1}					